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COMMENTS ON SPHAGNUM SECT. SPHAGNUM IN SOUTH AMERICA

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Nearly 50 years have passed since Andrews published his notes on the *Inophloea* group of *Sphagnum* in South America, based primarily on studies made in Warnstorf's herbarium at the Berlin Museum. Because many of Warnstorf's types were destroyed in time of war, Andrews' opinions on synonymies are indeed valuable, yet his well-known tendency to broaden specific limits invites caution. Fortunately, Warnstorf presented us with detailed and, in the main, accurate descriptions, and in many cases duplicates of his types can be located. Some few of them I have seen. In this interim report on the section, I can offer some improvements on our knowledge of the group, providing answers to some problems, leaving others for future consideration. Needless to say, I am in considerable disagreement with Andrews' views.

The section *Sphagnum,* also known as the *Cymbifolia* and the *Inophloea,* is characterized by tumid branches with broad, cucullate-concave leaves that are bordered by a resorption furrow and roughened at back at the apex by resorption in the form of membrane gaps. The hyaline cells of branch leaves have, on their outer surfaces, bordered, elliptic pores grouped in 3's at adjacent angles. The cortical cells of both stems and branches commonly have delicate spiral fibrils and one or more pores on the outer surface. The stem leaves are usually flat, lingulate, and fringed at the margins.

In his *Sphagnologia Universalis,* of 1911, Warnstorf provided descriptions for nearly 40 members of the section *Sphagnum* in South America. Andrews, in 1941, reduced that number to seven: *S. magellanicum* Brid., *S. erythrocalyx* Hampe, *S. palustre* L., *S. papillosum* Lindb., *S. alegrense* Warnst., *S. negrense* Mitt., and *S. submedium* Warnst. Indeed, many of Warnstorf's species, most of them from southern Brazil, do belong in synonymy, and a good number of them can be accommodated in the pan-tropical *S. perichaetiale* Hampe, as Andrews (1913, 1941) and Eddy (1977) have indicated. However, the number of species worthy of recognition is considerably larger than the seven that Andrews allowed. I have described seven as new, one of them in this contribution, and provisionally recognize 18.

I have seen no South American specimens of *S. palustre* or *S. papillosum* and consider their occurrence there phytogeographically improbable. Andrews attributed *S. palustre* to the flora on the basis of 12 species that he placed in synonymy. But ten of those were subordinated to *S. perichaetiale* by Eddy, who saw no evidence that *S. palustre* occurs anywhere in the Southern Hemisphere. (I have seen two collections of *S. palustre* from Mexico but none from other parts of tropical America.) Andrews attributed *S. papillosum* to the flora of Brazil on the basis of two species that he referred to synonymy, while indicating that neither of them, *S. brasiliense* Warnst. or *S. itacolumitis* C. M. & Warnst. ex Warnst., is entirely typical of that species of northern latitudes. I suspect that they both belong in the synonymy of *S. brevirameum* Hampe.

Eddy stated that the type of *S. erythrocalyx*, as represented at the British Museum, shows hyaline cells of branch leaves with papillae. Actually it is a mixture of *S. perichaetiale*, without papillae, and a small amount of a papillose species referable to *S. brevirameum*. This mixture is responsible for considerable confusion concerning papillosity in *S. erythrocalyx* and a supposed relationship to *S. papillosum* (Crum 1989b). An inclusive and, I think, unacceptable concept of *S. papillosum* is revealed by Andrews' view of *S. erythrocalyx* as little more than *S. papillosum* lacking papillae on the sidewalls of branch leaf hyalocysts. Even though *S. erythrocalyx*, actually a synonym of the older *S. perichaetiale* (Crum 1989a), is somewhat characterless and quite variable and *S. papillosum* sometimes lacks papillae, the species are really quite different.

Obviously following Andrews' lead, Yano et al. (1985) reported *S. palustre* from many parts of southern Brazil and also recorded *S. papillosum* from Bahia and Minas Gerais. Presumably all their material reported as *S. palustre* and *S. erythrocalyx* can be referred to *S. perichaetiale*, and that called *S. papillosum* most likely belongs to *S. brevirameum* (given a detailed description in Crum, 1989b). Griffin (1981) also used *S. palustre* as a name for Venezuelan and Colombian collections that also probably belong in *S. perichaetiale*. *S. perichaetiale* and its variations have been discussed by Crum and Buck (1988) and Crum (1989b). The species has accumulated a very extensive synonymy over its broad range. (Eddy listed 52 synonyms.) The species is generally recognizable, because it is so common and expected and also because of its small size, uniporose cortical cells lacking fibrils, and branch leaf hyalocysts having on their outer surfaces large, ringed pseudopores grouped in 3's at adjacent corners (and usually no pores at all or only a scattered few). The green cells of branch leaves show some variation in sectional views, being normally fusiform and exposed by thick walls at both ends but often trapezoidal to triangular-ovate (thus accounting for Andrews' distributing so many synonyms of *S. perichaetiale* into *S. palustre*).

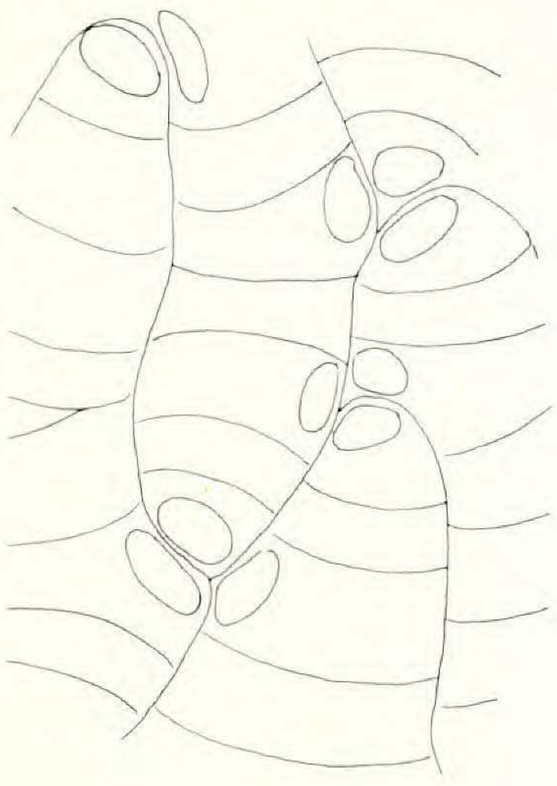
Sphagnum imbricatum Hornsch. ex Russ. was reported by Warnstorf from the island of Chiloé (Chile), but Andrews was unable to find a specimen in Warnstorf's herbarium. That species of broad distribution in the Northern Hemisphere has been found in Cuba and Belize and was recently reported by Yano et al. (1985) from São Paulo and Paraná. Their illustrations, if indeed based on Brazilian specimens, seem to confirm the identification. The species has broadly triangular green cells, as seen in section, and the adjacent side walls of hyaline cells are ornamented by comb fibrils. (*Sphagnum henryense* Warnst., a common species of the coastal plain of the eastern United States and a scattering of inland localities, has been found in Cuba and can perhaps be expected elsewhere in Latin America. It is somewhat like *S. imbricatum*, but an important distinction is provided by its undivided stem leaf hyalocysts.)

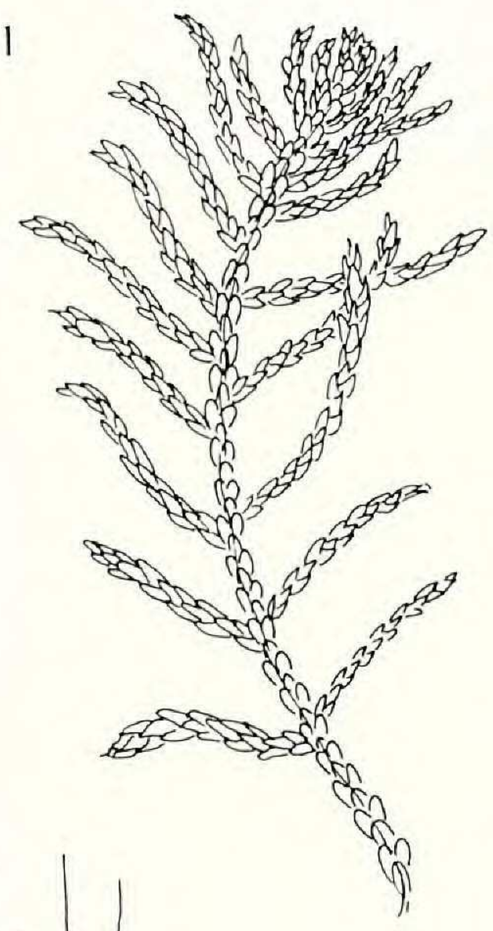
Sphagnum portoricense Hampe, which Andrews considered a derivative of *S. imbricatum*, has been found in Venezuela. It also occurs in Puerto Rico, Guadeloupe, and Nicaragua, as well as on the coastal plain of the eastern United States. It grows submerged or emergent in the North, but in the tropics it is apparently limited to wet mountain banks. It has club-shaped branches, cortical cells of branches nested together by funnel-like bases, and green cells of branch leaves broadly triangular in section with adjacent walls of hyaline cells bearing fringe fibrils.

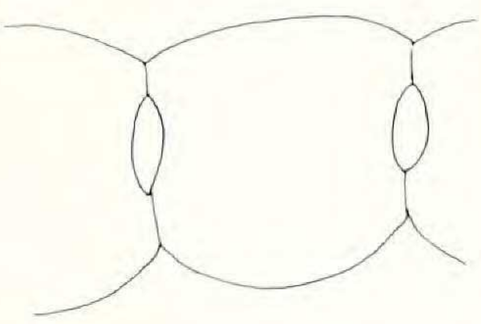
Sphagnum magellanicum Brid. is so widespread and so common in northern latitudes that one tends to forget that it was described from the Southern Hemi-

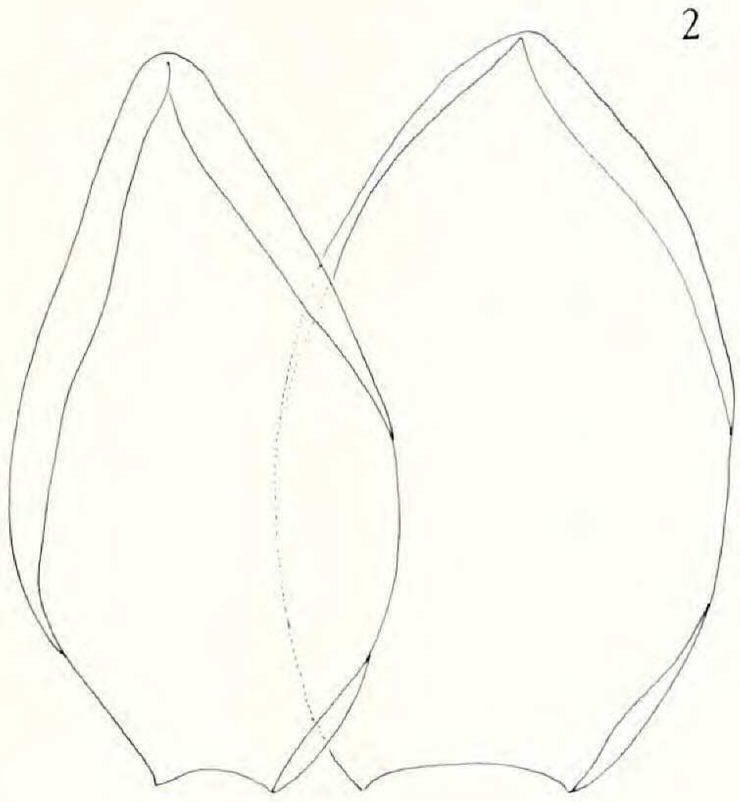
sphere and named in reference to the Straits of Magellan. It is an upland species found the length of the Andean chain and also in Brazil and Paraguay. The plants normally grow exposed to the sun and in response become a pink, red, or purple. The cortical cells of stems and branches are delicately fibrillose; the branch leaf hyalocysts are flat on both surfaces; the green cells in section are shortly elliptic and entirely included; and the hyaline cells are plane on both surfaces.

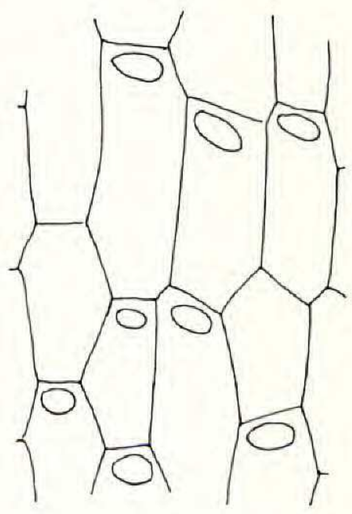
Andrews put *Sphagnum longistolo* C. M. ex Warnst. and *S. weddelianum* Besch. ex Warnst. into synonymy with *S. magellanicum*. I have seen no material of *S. weddelianum*, but *S. longistolo* seems quite recognizable (figs. 1–7). It differs

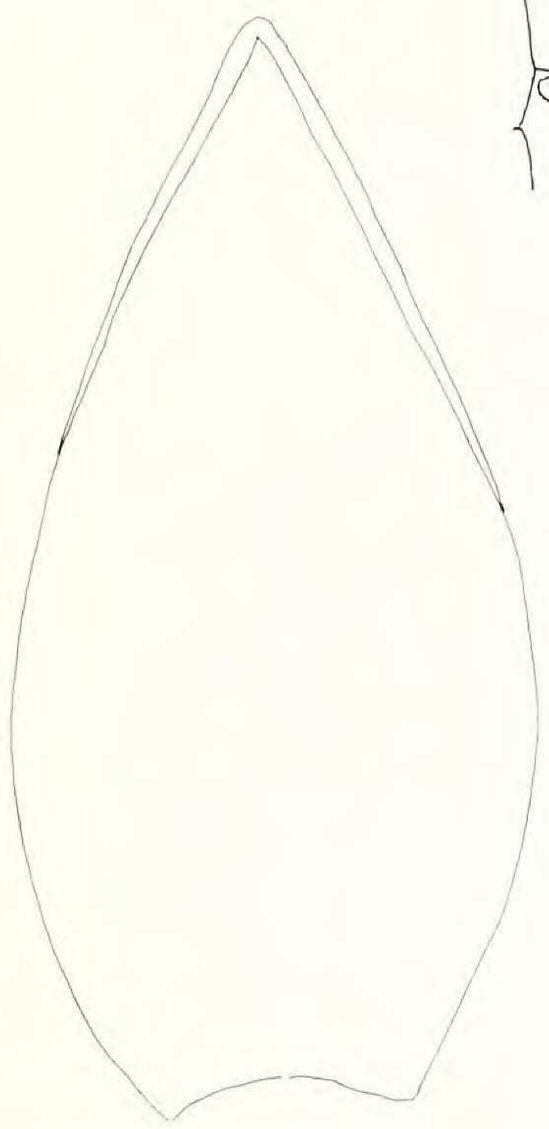


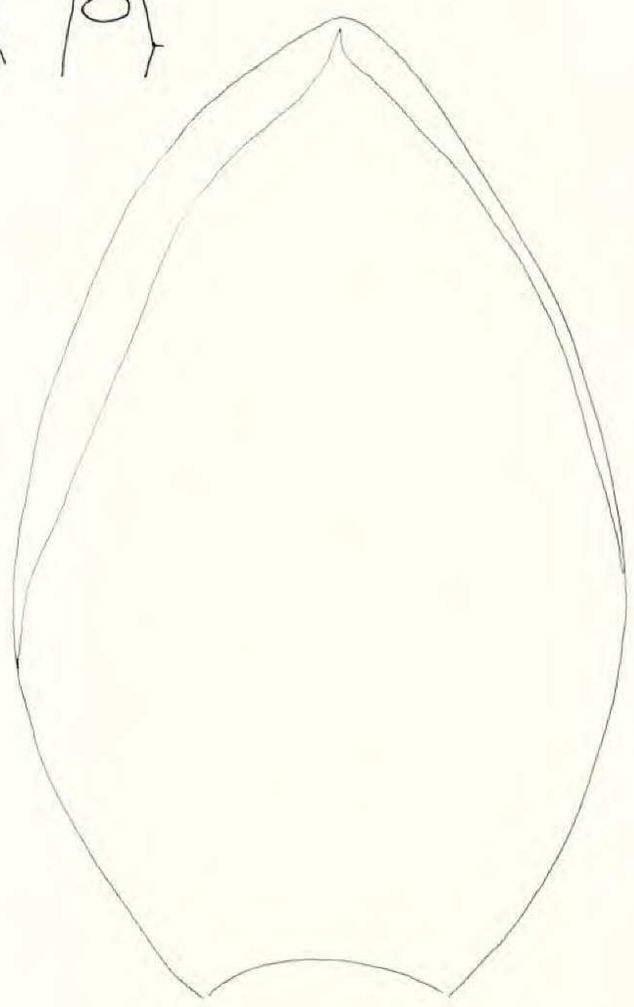


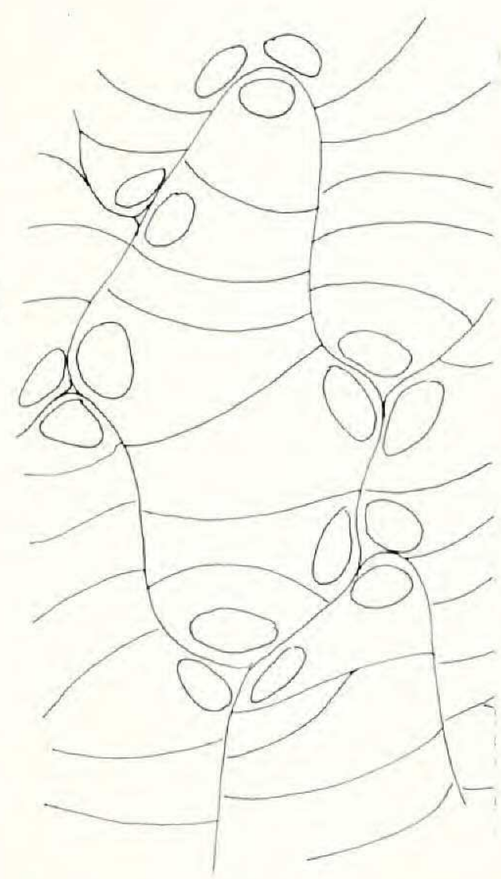












FIGS. 1–7. *Sphagnum longistolo*. 1. Habit, ×2. 2. Branch leaves, ×28. 3. Upper cells of branch leaf, outer surface, ×430. 4. Portion of branch leaf in section, ×430. 5. Stem leaves, ×28. 6. Upper cells of stem leaf, outer surface, ×430. 7. Cortical cells of stem, ×115.

significantly from *S. magellanicum* in having single rather than fascicled branches. The wood cylinder is red-brown, and the cortical cells of stems and branches are apically porose and efibrillose. The stem leaves, much like branch leaves, are hooded-concave and bordered by a resorption furrow, and they have hyaline cells porose and fibrillose throughout. The hyaline cells of branch leaves are moderately convex on both surfaces.

I have seen several collections from Brazil, including two named by Warnstorf. Lange (1979) studied duplicates of those same specimens (*Ule 291, 292*) as well as an isotype (at Hamburg, *Ule 1227*). She also examined five specimens that Warnstorf named *S. weddelianum,* but not the type. Some of those she found to be *S. longistolo,* while others conform to the specifications of *S. weddelianum.* Whether that means that Warnstorf was mistaken in his identifications or that the species intergrade was not made clear. *Sphagnum weddelianum* has paired branches and, according to Lange, a brown wood cylinder and shorter, narrower stem leaves (1.4–1.7 mm long, as opposed to 1.8–2.7 mm or more).

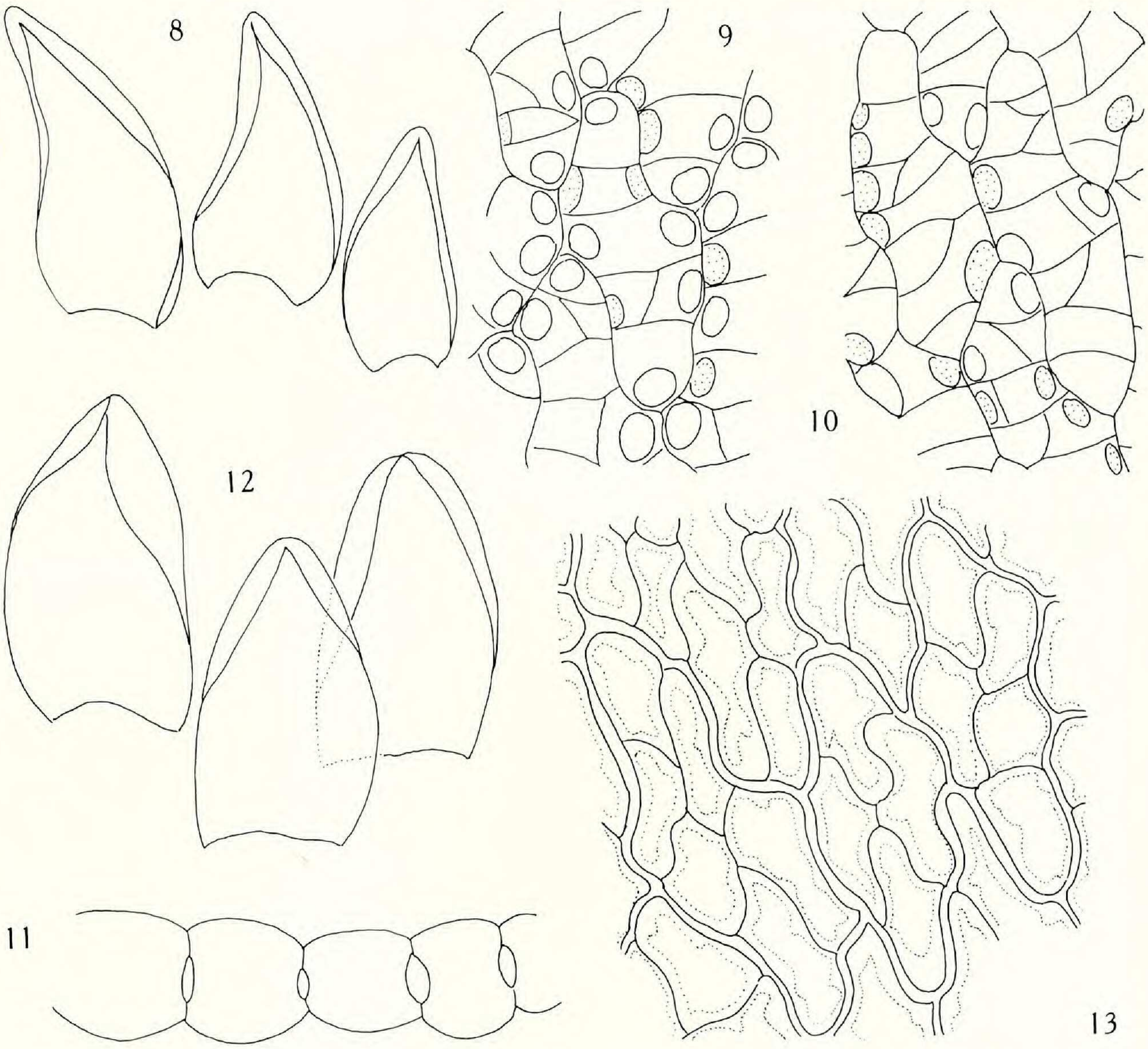
Lange reported *S. longistolo* from Peru (at 3000 m alt. in Chachapoyas province), and Yano et al. (1985) cited a large number of collections from five Brazilian states. They seem to have included *S. weddelianum* in their concept of *S. longistolo.* They characterized the branches as single or rarely double, with one branch small and pendent, and the branch cortex sometimes weakly fibrillose. Inexplicably, they figured it as decidedly fibrillose. Lange saw fibril traces in a few cells in the isotype of *S. longistolo.* I saw none in specimens available to me.

Sphagnum sanguinale Warnst. was referred by Andrews to the synonymy of *S. magellanicum,* but, most distinctively (figs. 8–13), it has cortical cells of stems uniporose and efibrillose, hyaline cells of stem leaves once to several times-divided, branch leaves spreading and 5-ranked when dry, less spreading but noticeably spiral-ranked when moist, and hyaline cells of branch leaves with numerous commissural pores and pseudopores on both surfaces. The only significant features it has in common with *S. magellanicum* are the red coloration (not at all dark- or blood-red as described) and the nature of the branch leaves in section. I have seen an isotype specimen from British Guiana (*Quelch & McConnell 350,* from Mt. Roraima, NY, dupl. ex herb. Kew), but no specimens from Bahia, Brazil, as cited by Warnstorf (1911). A Venezuelan collection (Bolívar, distr. Piar, ca. 1920 m. alt., *Luteyn et al. 9534,* NY) can be referred here.

I have no opinion on other species that Andrews placed in synonymy with *S. magellanicum: S. amoenum* Warnst., *S. rigescens* Warnst., *S. stewartii* Warnst., and *S. vesiculare* C. M. & Warnst. ex Warnst.

Sphagnum alegrense Warnst. resembles *S. magellanicum* in branch leaf structure, more specifically, in the central, included green cells. But the branch leaf hyalocysts, where they abut on green cells, are covered by fine, wormlike marks appearing in section to be papillae, few in number, variable in size. Also, the cortical cells essentially lack fibrils. The type is Brazilian. I have seen specimens from Brazil, Venezuela, Guadeloupe, and Dominica. A record from Panama (Allen 1986) I refer, with some uncertainty, to *S. perichaetiale.* The author had some difficulty in demonstrating vermiform markings, and I saw none. The pores on branch leaf hyalocysts I found better developed than usual in *S. perichaetiale.*

Warnstorf (1891) considered *S. husnotii* Schimp. ex Besch. (as represented by



FIGS. 8–13. *Sphagnum sanguinale*. 8. Branch leaves, ×28. 9. Upper cells of branch leaf, outer surface, ×430. 10. Upper cells of branch leaf, inner surface, ×430. 11. Portion of branch leaf in section, ×430. 12. Stem leaves, ×28. 13. Upper cells of stem leaf, outer surface, ×430.

Husnot's *Pl. Antilles 89*) to be *S. guadalupense* Schimp. ex Besch., which he illustrated from type material (Guadeloupe, *Marie,* in herb. Bescherelle). His figures of branch leaf sections show a probable identity with *S. alegrense.* (If those species should be synonymous, the name available for use would be either *S. guadalupense* or *S. husnotii,* both dating from 1876. *Sphagnum alegrense* dates from 1907.) However, in 1911, Warnstorf appears to have changed his mind. He again considered *S. guadalupense* as including *S. husnotii* but said that the hyaline cells of branch leaves are smooth and described the green cells as fusiform to barrel-shaped and exposed on both surfaces or only on the inner. Andrews (1913) referred both *S. guadalupense* and *S. husnotii* to the synonymy of *S. erythrocalyx,* in other words, to *S. perichaetiale.* Eddy did not include either name in his extensive synonymy of *S. perichaetiale.*

Warnstorf synonymized *S. guyonii* Warnst. (of Martinique) with *S. guadalupense.* However, he illustrated branch leaf sections like those of *S. perichaetiale,* and that is where both Andrews (1913) and Eddy (1977) placed the species.

Andrews (1941) included *S. bahiense* var. *sincorae* Warnst. in *S. alegrense* but considered the species proper, *S. bahiense* Warnst., synonymous with *S. erythrocalyx* (*S. perichaetiale*).

Eddy included *S. negrense* Mitt. in *S. perichaetiale* Hampe. It was, however, recognized by Andrews as worthy of species rank. Mitten (1869) cited four numbered collections: "Fl. Negro, ad rupes cataractae S. Gabriel irroratas, *Spruce*, n. 1507; ad cataractam Tamandúa, *Spruce*, n. 1508; ad cataractam S. Gabriel, *Spruce*, n. 1509; ad cataractam Carangueja, *Spruce*, n. 1510." In the Mitten herbarium, at New York, are seven specimens, three numbered in pencil in Mrs. Britton's hand. There is no 1509 or 1510. The no. 1508 (moist rocks at the falls . . . Tamandúa below mouth of Napis) can be referred to *S. perichaetiale*. All the other specimens belong to *S. negrense*. Two numbered 1507 represent very different growth forms: The one labeled "falls of S. Gabriel" has elongate branches resembling stems, in appearance, not in structure. The other, labeled "Rio Negro, in rupibus humidis cataractarum São Gabriel," has nicely differentiated stems and branches. I designate it as the LECTOTYPE. It is similar to the two unnumbered specimens, one labeled merely "Rio Negro," the other "in ripis fl. Negro prope S. Carlos."

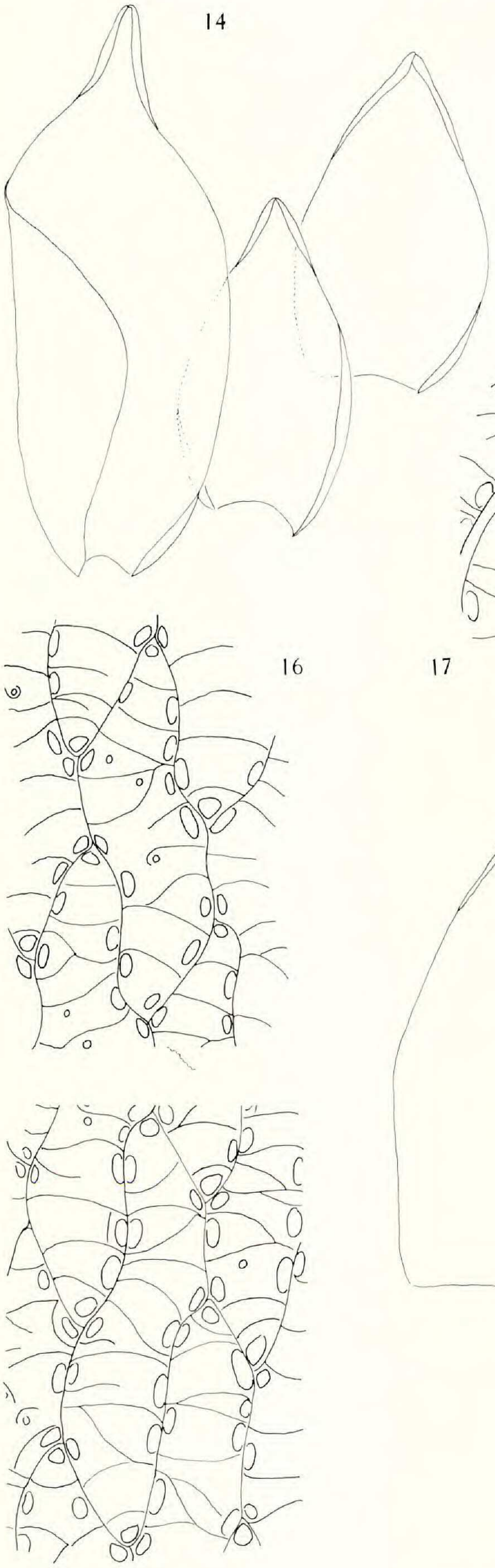
São Gabriel is well inside Brazilian territory, but San Carlos is in Venezuela, just across the Río Negro from Colombia. No other localities are known for the species, but the range no doubt includes Colombia as well as Venezuela and Brazil.

Sphagnum negrense (figs. 14–18) has branch leaves hooded at the apex and provided with pores in threes at adjacent cell corners on the outer surface and also numerous small, ringed pores at the commissures and often (mainly on the outer surface) a few minute, round pores on cell middles, especially toward the leaf apex. The stem leaves are somewhat concave at the tips and have hyaline cells fibrillose throughout and similarly porose. Like the branch leaves, they are bordered by a resorption furrow. The cortical cells of stems and branches are porose at their upper ends and lack fibrils.

Sphagnum submedium Warnst. was placed by Eddy in synonymy with *S. perichaetiale*, but I agree with Andrews that it is quite distinct and very interesting, too (figs. 19–25). It resembles *S. perichaetiale* only in the sectional views of green cells. Warnstorf described them as similar to those of *S. erythrocalyx*, but Andrews found them like those of *S. magellanicum*. Actually, in the type collection, some sections show green cells central and included, as in *S. magellanicum*, but most of them show narrow cells exposed on both surfaces owing to wall thickenings at both ends, as in *S. perichaetiale*. The stem leaves are very broad, almost rounded, though cucullate-tipped and in structure much like branch leaves, having a resorption furrow all around and hyaline cells with very small, strongly ringed corner pores on the outer surface (grouped in threes at adjacent cell angles). Both stem and branch cortical cells lack fibrils and only rarely have pores (at the upper ends). I have seen an isotype from the New York Botanical Garden (shaded bank of Rio Verdinho, Caldas, Minas Gerais, *Mosén*, Dec. 15, 1873).

Sphagnum simplicicaulis Crum, sp. nov. Fig. 26–32.

Plantae pallide fuscae. Caules simplices vel rare furcati, 2–3 mm altitudine, obscure fusci vel atri; hyalodermis stratis duobus, tenuiter fibrosis, uniporosis; cylindrus lignosus obscure fuscus. Folia 2.5–2.8 mm longa, late ovata, cucullato-concava, dorso pseudoporis vel poris veris ternis in cellularum angulis conjunctis, interiore superficie pseudoporis plus minusque numerosis, saepe in series breves ad commissuras dispositis instructa; cellulae chlorophylliferae sectione transversali anguste triangulae, interiore superficie liberae.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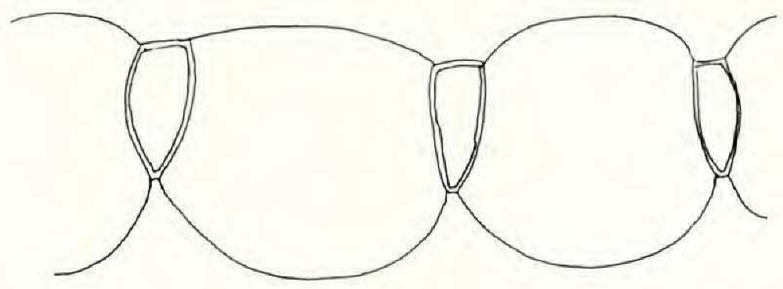
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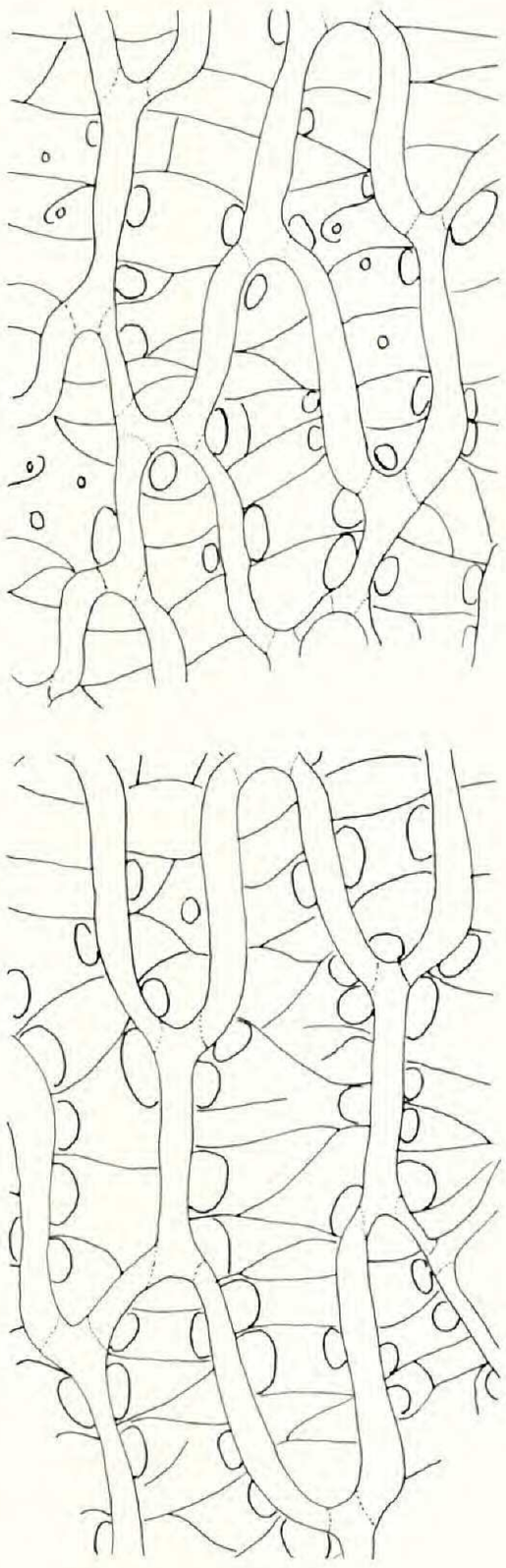

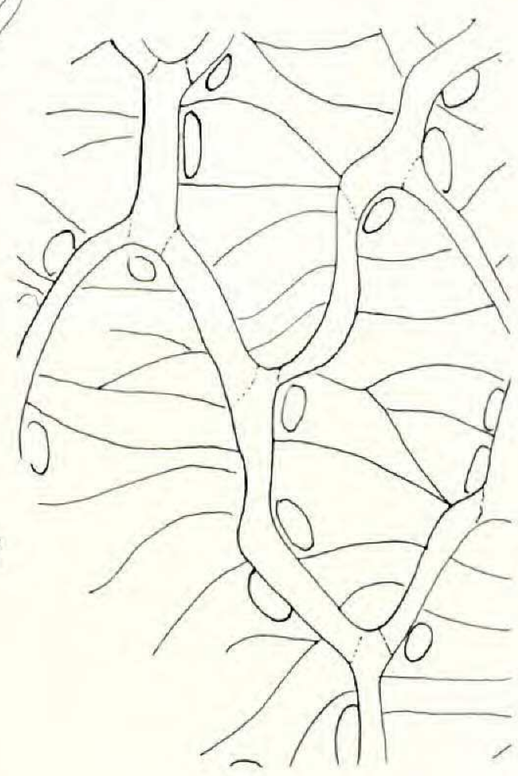
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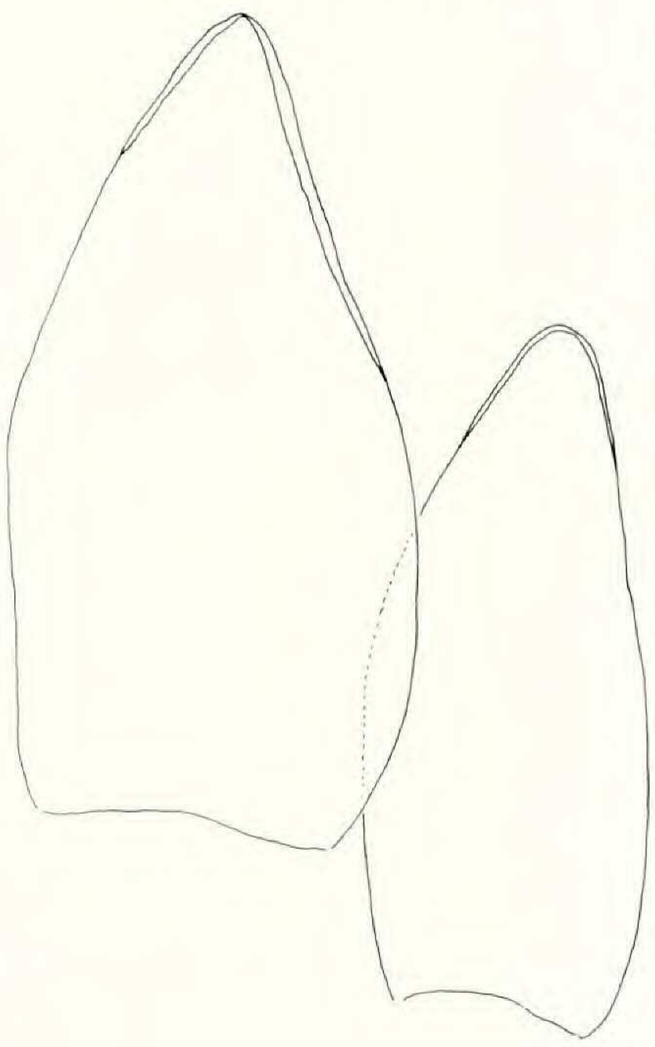

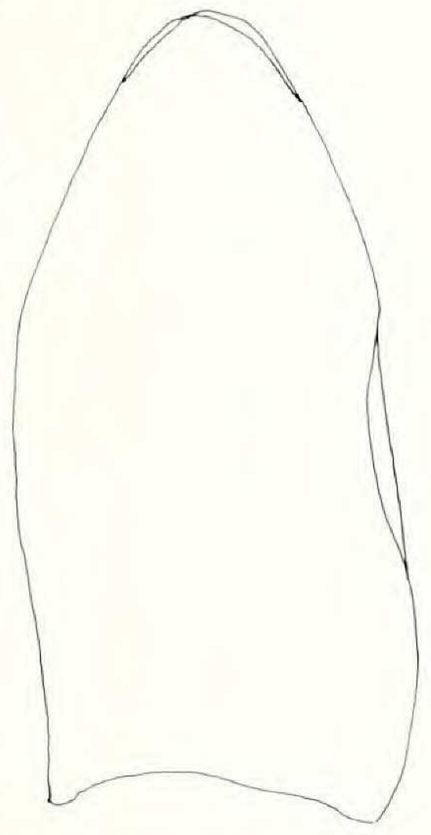
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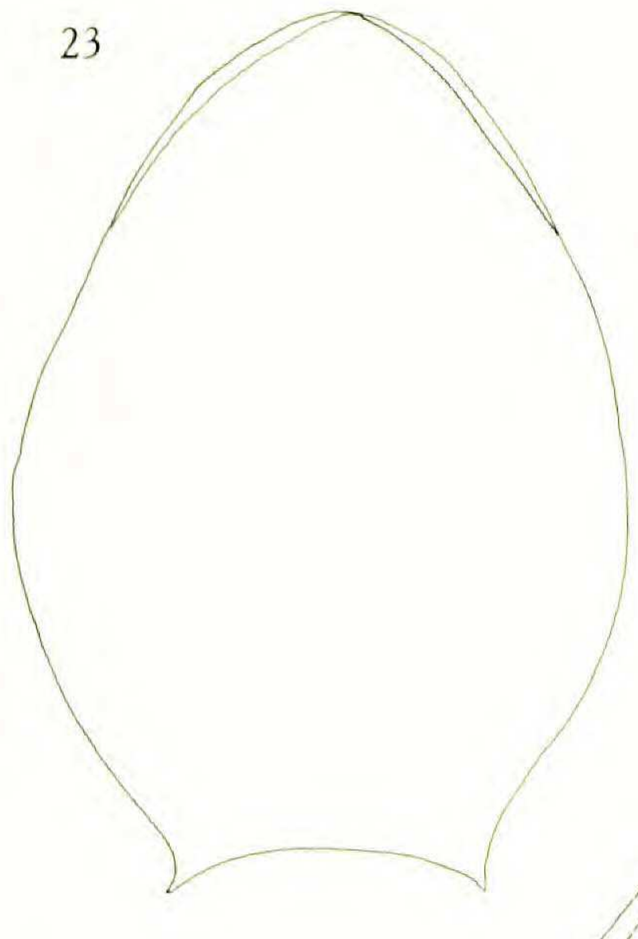
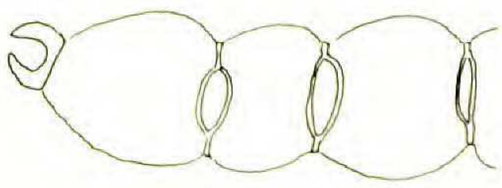
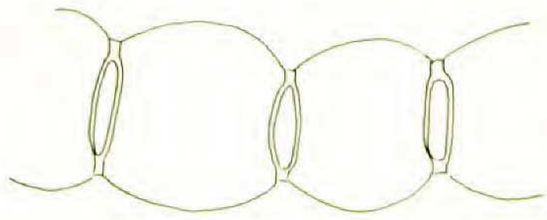
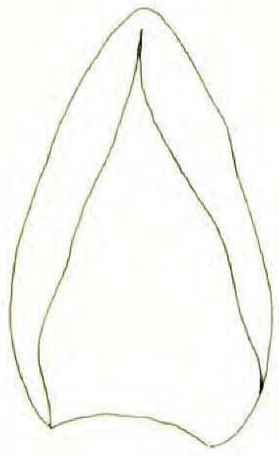
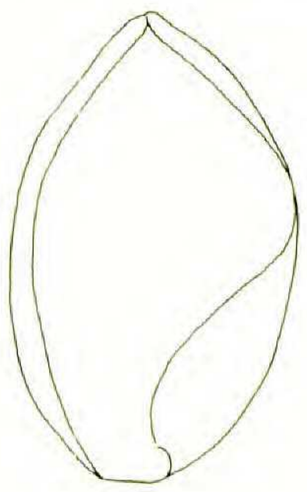
FIGS. 14–18. *Sphagnum negrense*. 14. Branch leaves, ×28. 15. Portion of branch leaf in section, ×430. 16. Upper cells of branch leaf, outer surface (2 views), ×430. 17. Upper cells of branch leaf, inner surface (3 views), ×430. 18. Stem leaves, ×28.

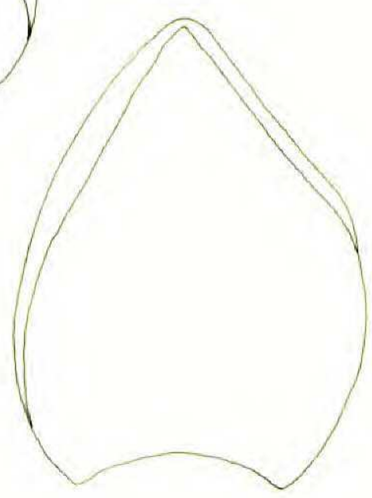


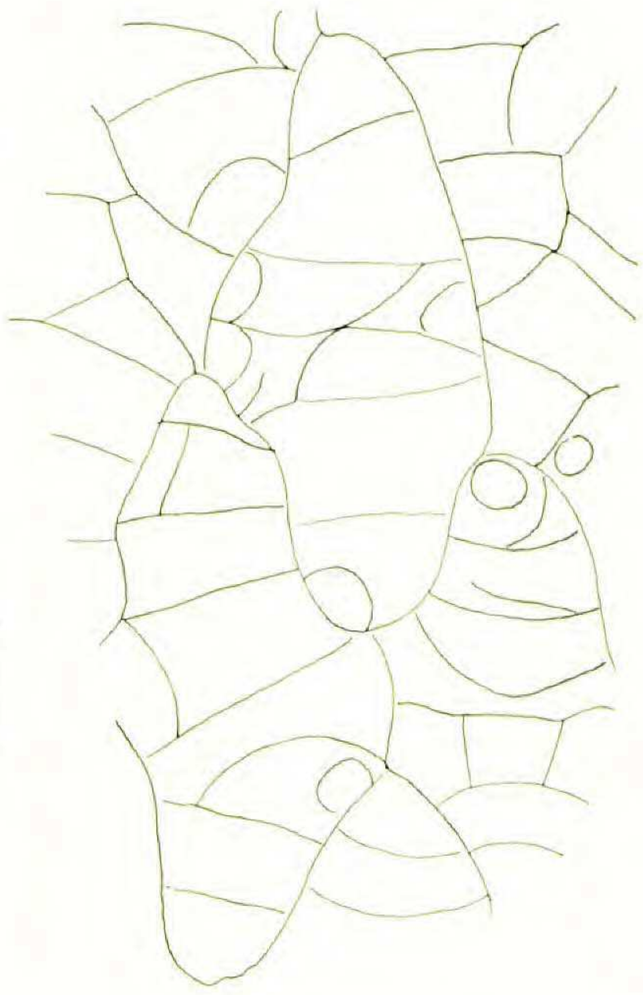


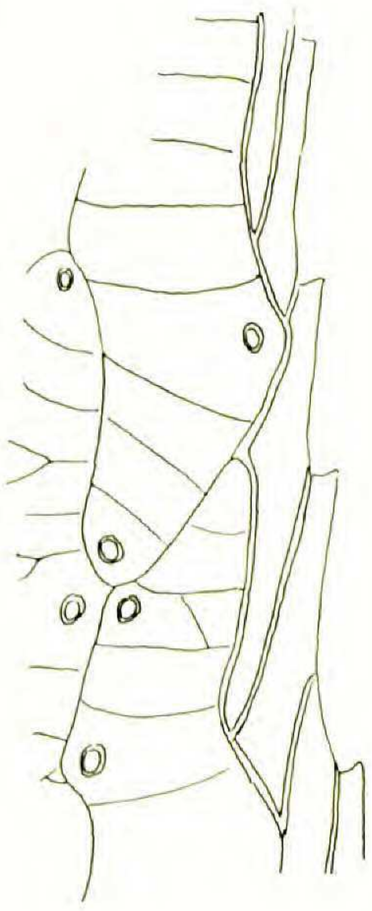


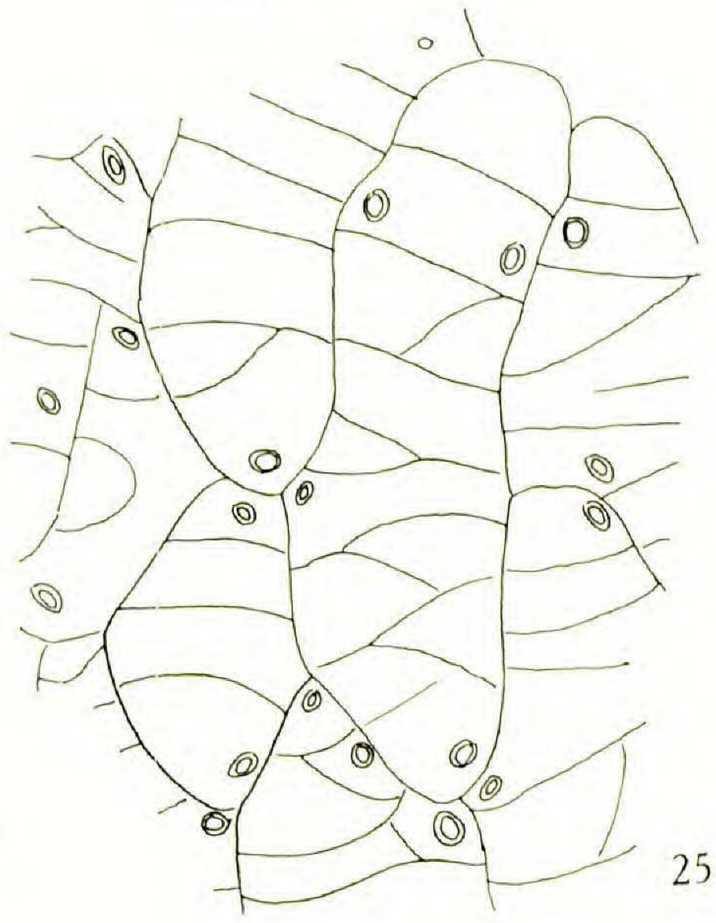


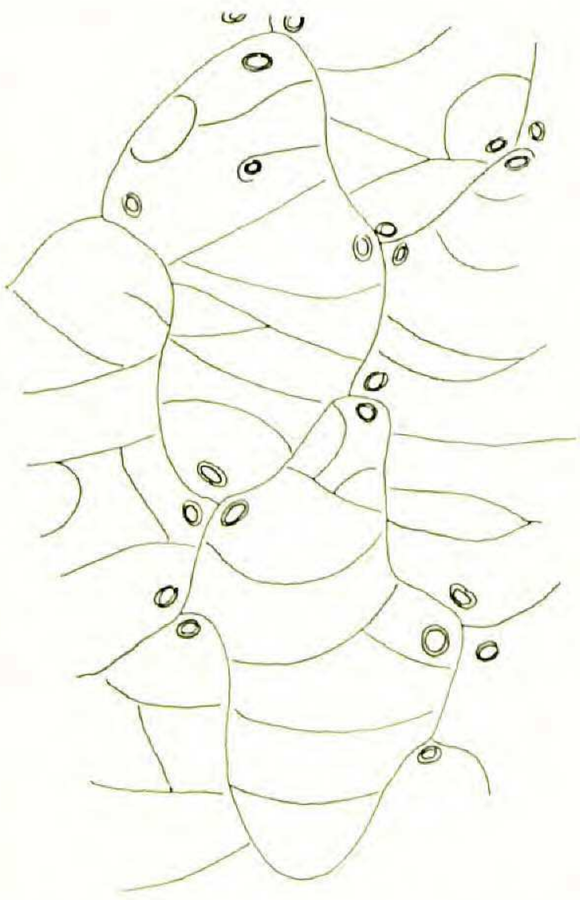






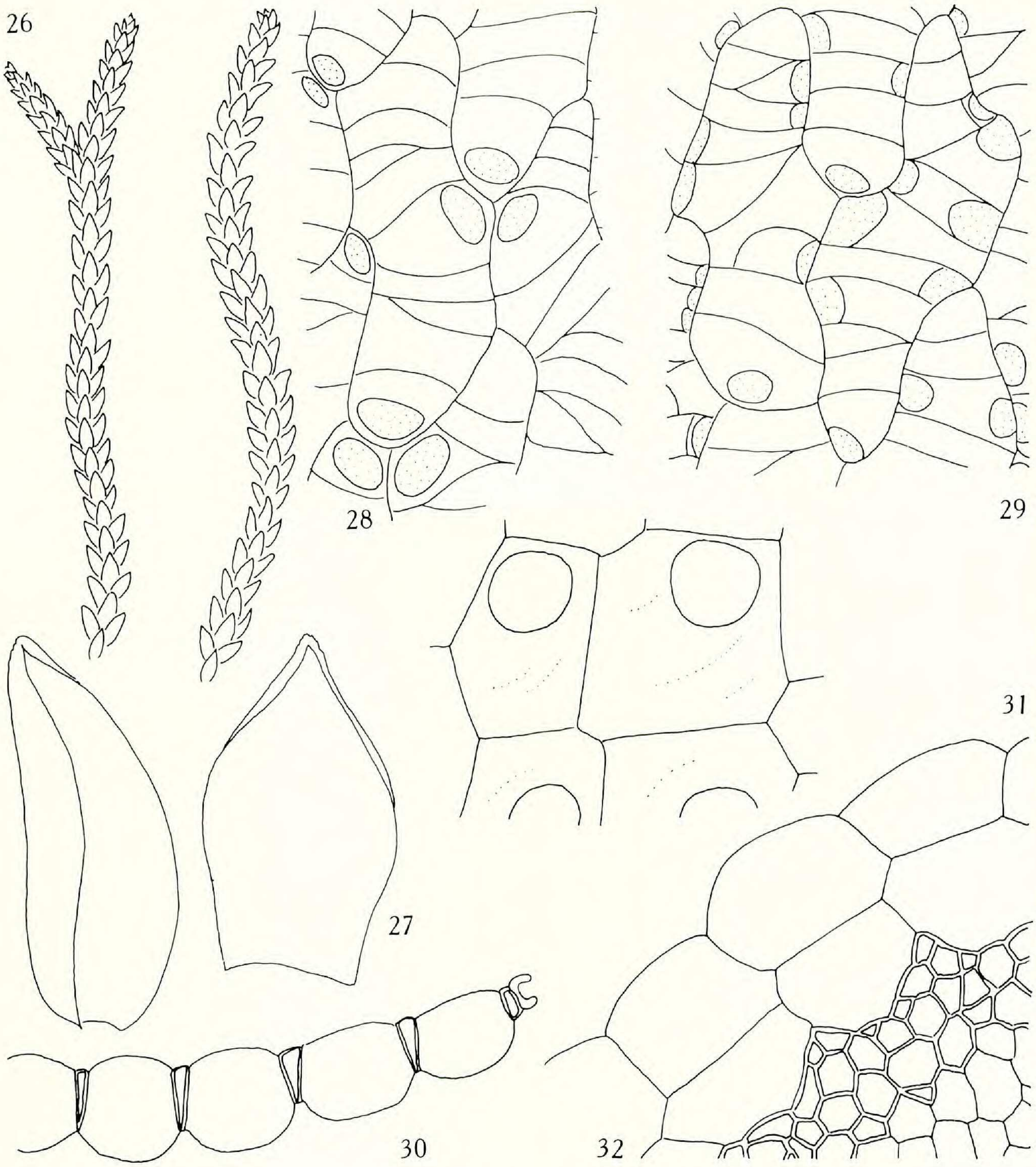






FIGS. 19–25. *Sphagnum submedium*. 19. Branch leaves, ×28. 20. Portions of branch leaves in section, ×430. 21. Upper cells of branch leaf, outer surface, ×430. 22. Upper cells of branch leaf, inner surface, ×430. 23. Stem leaf, ×28. 24. Upper marginal cells of stem leaf, ×280. 25. Upper median cells of stem leaf, ×430.

Plants 2–3 mm high, tumid, pale-brown or tawny, simple or occasionally 1-forked. Stems dark- to blackish brown; wood cylinder dark-brown; cortical cells in 2 layers, the outer cells quadrate, uniporose, very delicately fibrillose. Leaves crowded, somewhat spreading, 2.5–2.8 mm long, broadly oblong-ovate, cucullate-concave, denticulate-bordered by a resorption furrow and roughened at back of the apex; hyaline cells somewhat convex on the outer surface, nearly plane on the inner, on the outer surface with ringed, elliptic pseudopores or, in the midsection of the leaf, with some true pores, in 3's at adjacent angles, on the inner surface with few to numerous round to elliptic pores (varying in size and shape) at cell corners and along commissures, often in series of 2–3; green cells very narrowly triangular,



FIGS. 26–32. *Sphagnum simplicaulis*. 26. Habits, ×4. 27. Branch leaves, ×18. 28. Upper cells of branch leaf, outer surface, ×430. 29. Upper cells of branch leaf, inner surface, ×430. 30. Portion of branch leaf in section, ×430. 31. Epidermal cells of stem, ×430. 32. Portion of stem in section, ×430.

narrowly exposed on the inner surface, the hyaline cells somewhat convex on the outer surface.

VENEZUELA. Bolívar: Chimanta Massif, along rapids of Río Apácara in sandy soil, 415 m, ¼ mi downstream from mouth of Río Abácapa to mouth of Río Abácapa [sic], W side of Apácara-tepui, *Steyermark 74697*, March 29, 1953 (NY, holotype and isotype, sub *S. magellanicum*).

This species is unlike any other member of the section *Sphagnum* in its unbranched or rarely forked stems, in this way resembling *subsimplex* species or expressions of species in the section *Subsecunda*. However, structural details of both stems and leaves show an unquestioned relationship to the section *Sphagnum*. The poor differentiation of pores is interesting. On the outer surface, some pore

triplets can be seen (crowded together as chambered pores) at adjoining cells angles in the mid-section of leaves, but otherwise there are instead mainly pseudopores, well separated and poorly defined. On the inner surface are fairly numerous pseudopores of irregular shapes and sizes at cell corners and commissures, often in short rows of two or three.

For the purpose of reference, I mention here species that I have added to the section: *S. ornatum* Crum (1985), *S. harleyi* Crum (1987b), *S. imperforatum* Crum (1989b), *S. irwinii* Crum (1987a), *S. multiporosum* Crum (1987b), and *S. cucul-liforme* Crum (1987a). The last named species I placed in a new section, *Cucul-liformes*. I am now less certain of the value of that section. Further studies of species with poorly differentiated stem and branch leaves and branches with cortical cells of two kinds are needed. Such species are more numerous and more varied than I realized.

In summary, I suggest the following eighteen species as provisionally acceptable members of the section *Sphagnum:*

S. alegrense Mitt. (*S. bahiense* var. *sincorae* Warnst.)
S. brevirameum Hampe (*S. brasiliense* Warnst.?, *S. itacolumitis* C. M. & Warnst. ex Warnst.?)
S. cuculliforme Crum
S. harleyi Crum
S. imbricatum Hornsch. ex Russ.
S. imperforatum Crum
S. irwinii Crum
S. longistolo C. M. ex Warnst.
S. magellanicum Brid. (*S. amoenum* Warnst.?, *S. rigescens* Warnst.?, *S. stewartii* Warnst.?, *S. vesiculare* C. M. & Warnst. ex Warnst.?)
S. multiporosum Crum
S. negrense Mitt.
S. ornatum Crum
S. perichaetiale Hampe (*S. erythrocalyx* Hampe!, *S. husnotii* Schimp.?, *S. guada-lupense* Schimp. ex Besch.?, *S. guyonii* Warnst.?, *S. bahiense* Warnst.?)
S. portoricense Hampe
S. sanguinale Warnst.
S. simplicicaulis Crum
S. submedium Warnst.
S. weddelianum Besch. ex Warnst.

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